Scanning Optical Micro Interferometer

IAB Presentation

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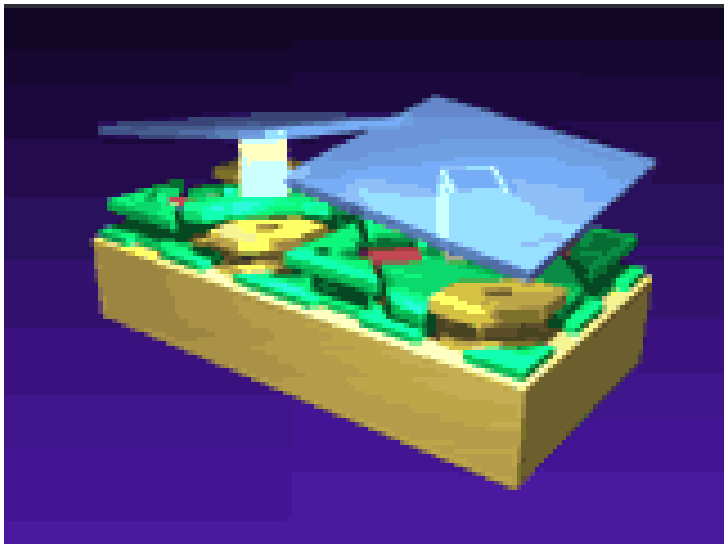
Problem Statement

- Fabrication of MEMS devices has progressed faster than our ability to generate useful measurement data, i.e. metrology methods are lacking
- In particular, 3-dimensional data is currently impossible to achieve with current technology
- An example MEMS device is the Digital Light Processor made by TI



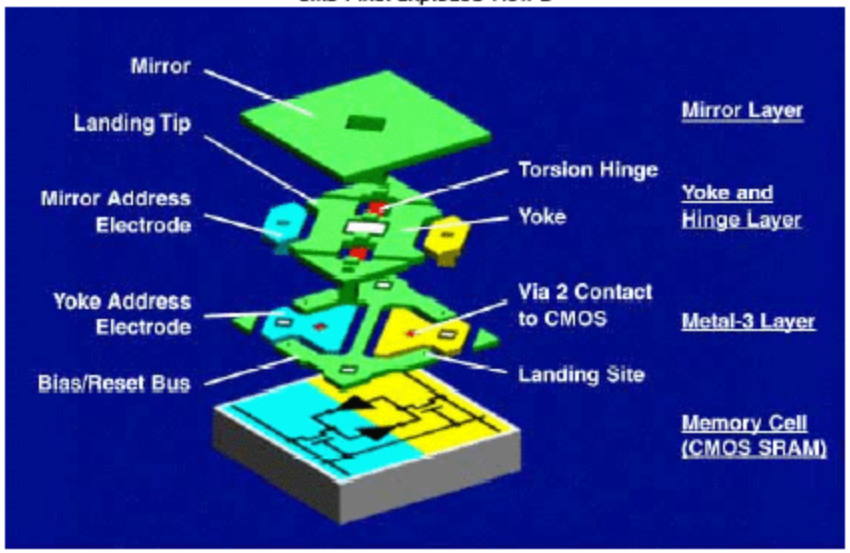
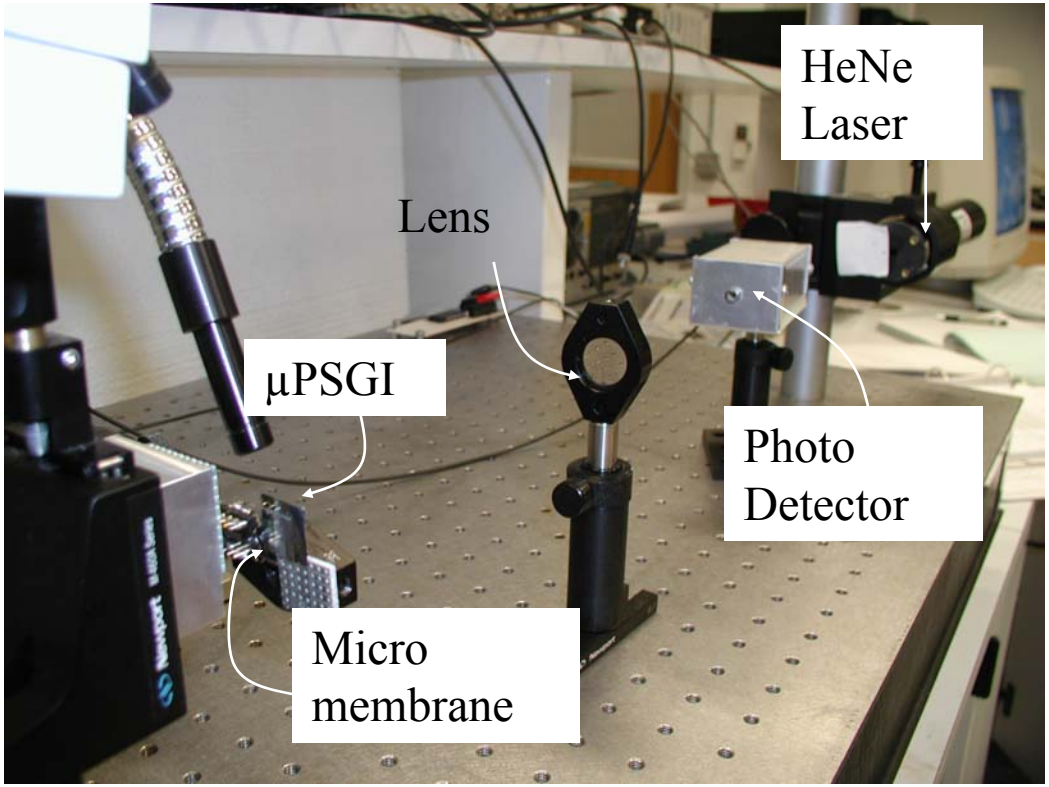


Figure 6

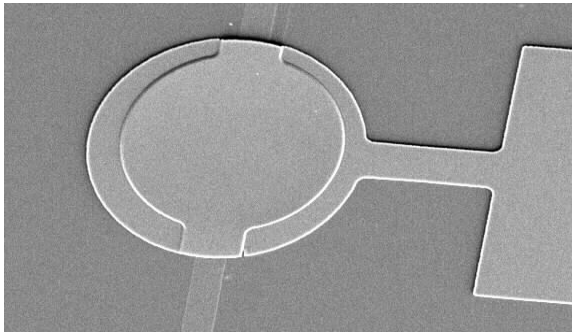
System Setup

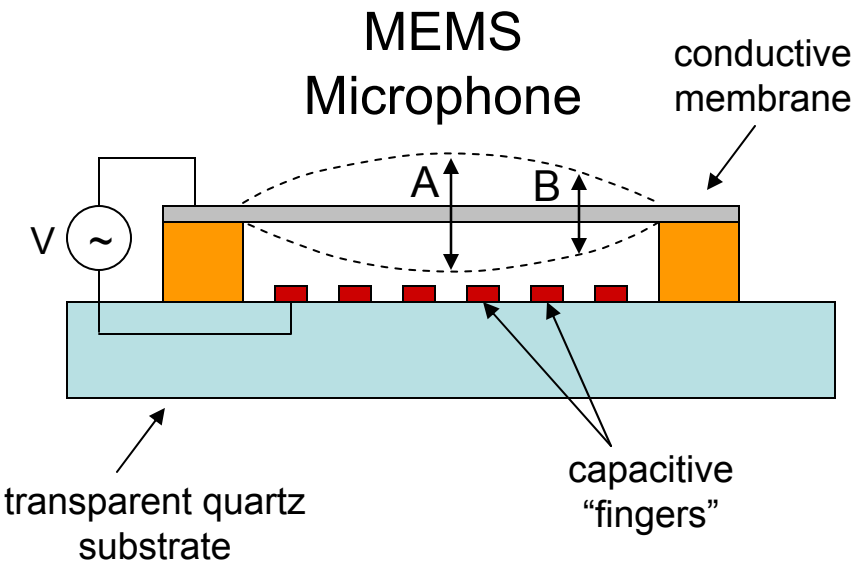
- The MEMS device is on a 4 axis motorized stage
- The first interference fringe is picked up by the photodetector and the intensity of the light measured



System Setup

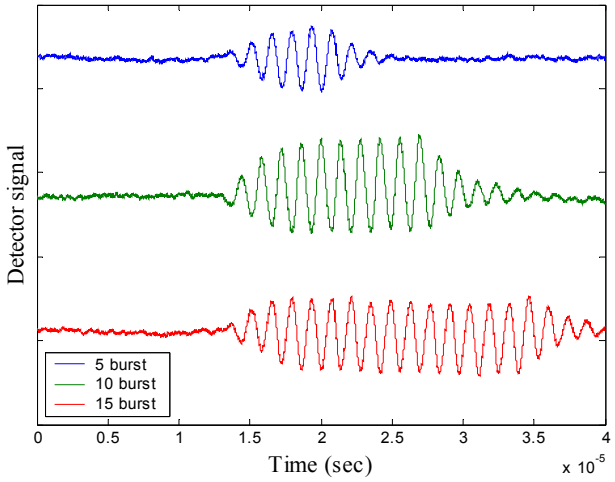
- If the microphone is excited with an AC signal, it will move as shown due to capacitive forces
- The amplitude of the motion at point A will be greater than at point B
- This motion will be detected by the interferometer in the form of a varying light intensity

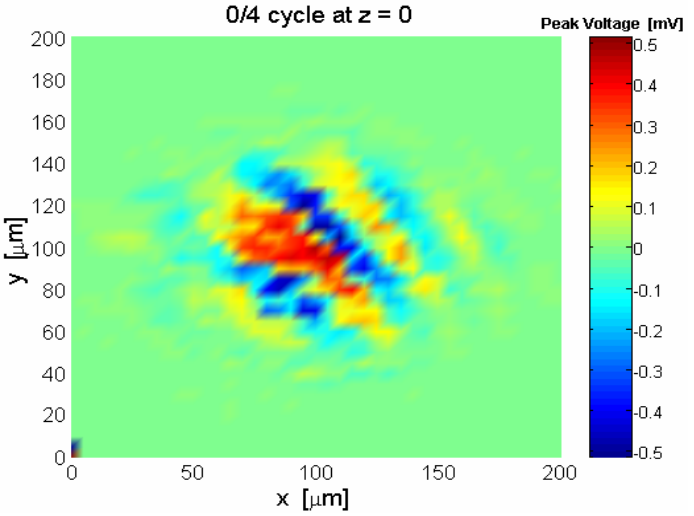




Previous Work

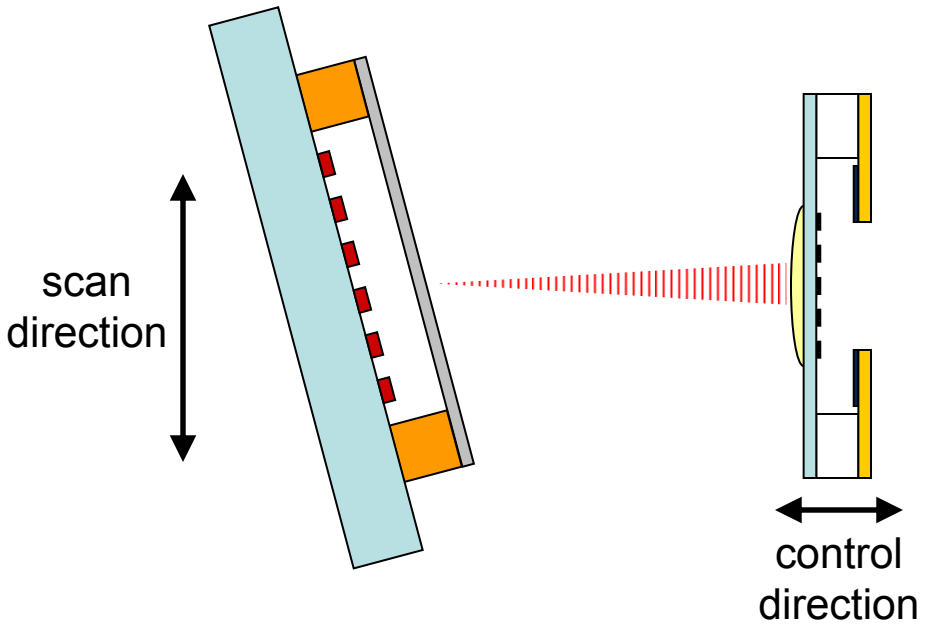
- The system was set up with the grating interferometer and the MEMS microphone
- Using tone bursts, data is collected on the actuation of the surface
- This actuator is a second order system similar to a mass-spring-damper
- Fringes were shown in the output





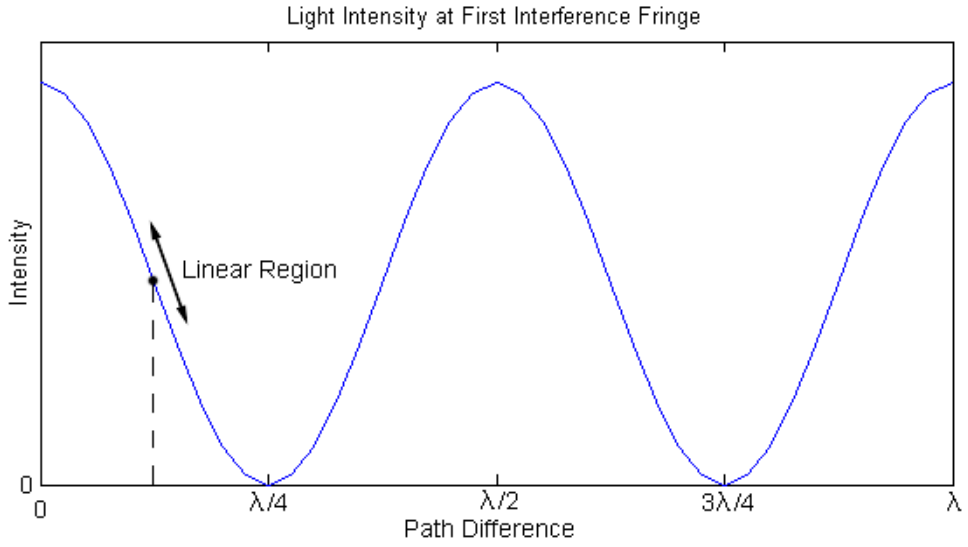
Current Work - Eliminating Fringes

- Fringes are created by the non-planarity of the devices
- The optical intensity “wraps around” if the distance between two points is greater than $\lambda/4$
- Vibration can also cause relative motion between the devices, creating erroneous results
- To correct for misalignment, the interferometer should “track” with the surface being scanned
- The grating and photodetector are attached to a piezo-electric transducer
- The error in the surface must be tracked and controlled in real time

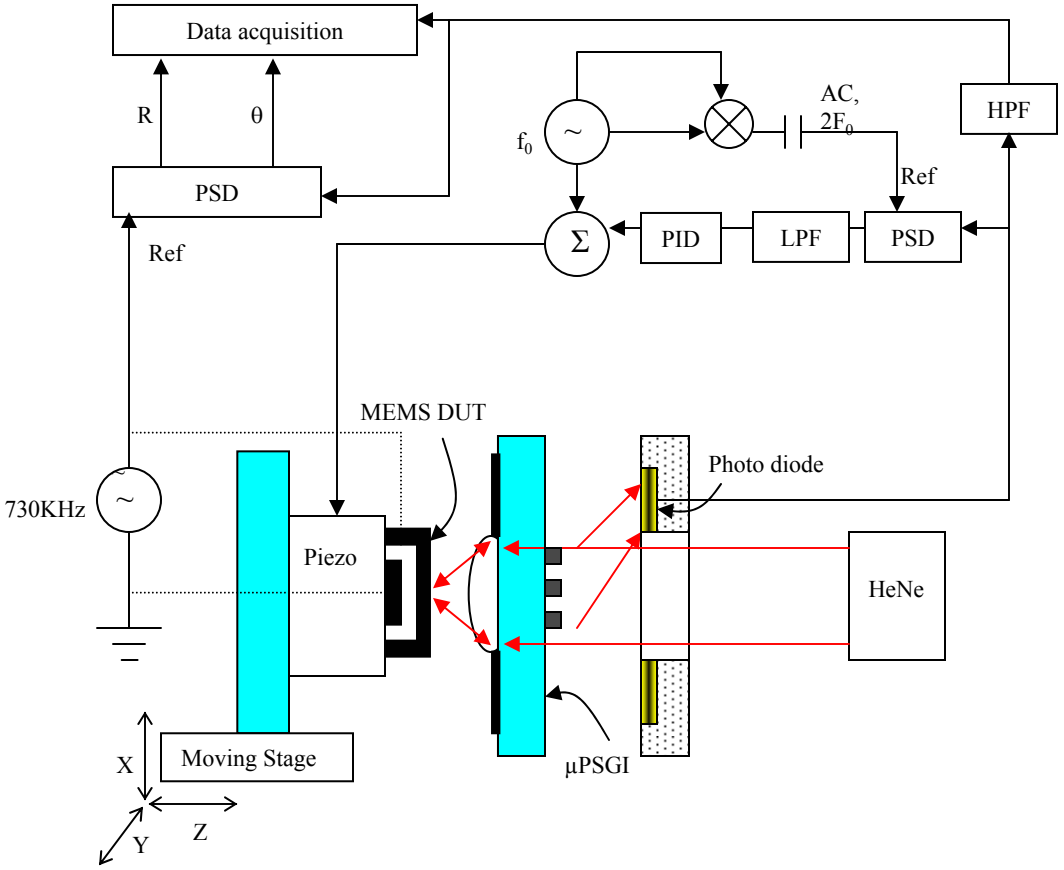


Tracking the Surface

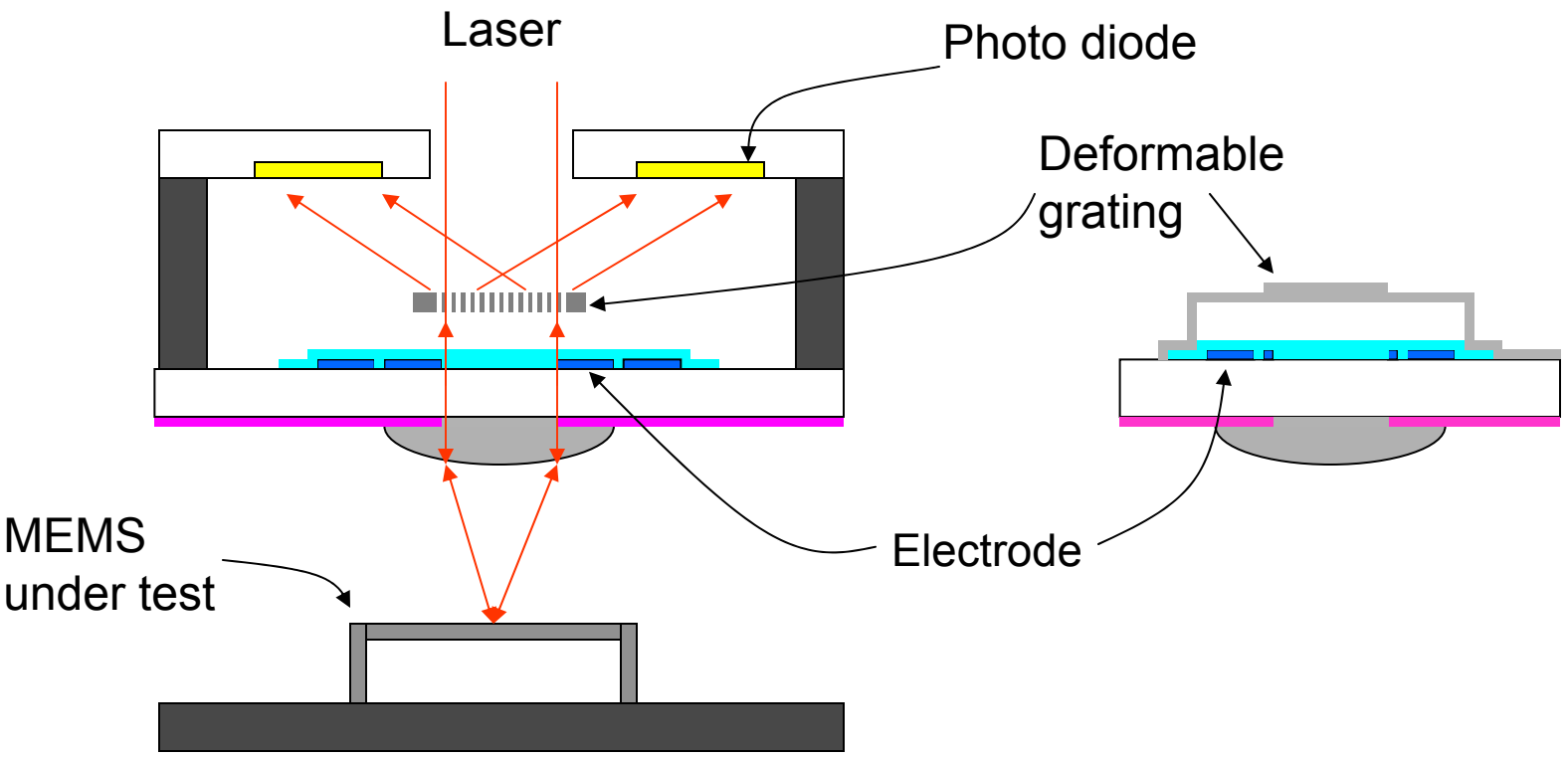
- The intensity detected by the photodetector follows a $\sin^2(\omega t)$ curve which is proportional to the path difference
- Therefore, the optimal point, or “sweet spot”, for sensing occurs in the middle of the optical intensity curve at $\lambda/8$
- Assuming that the small range around this point is linear, allows one to construct a linear control system



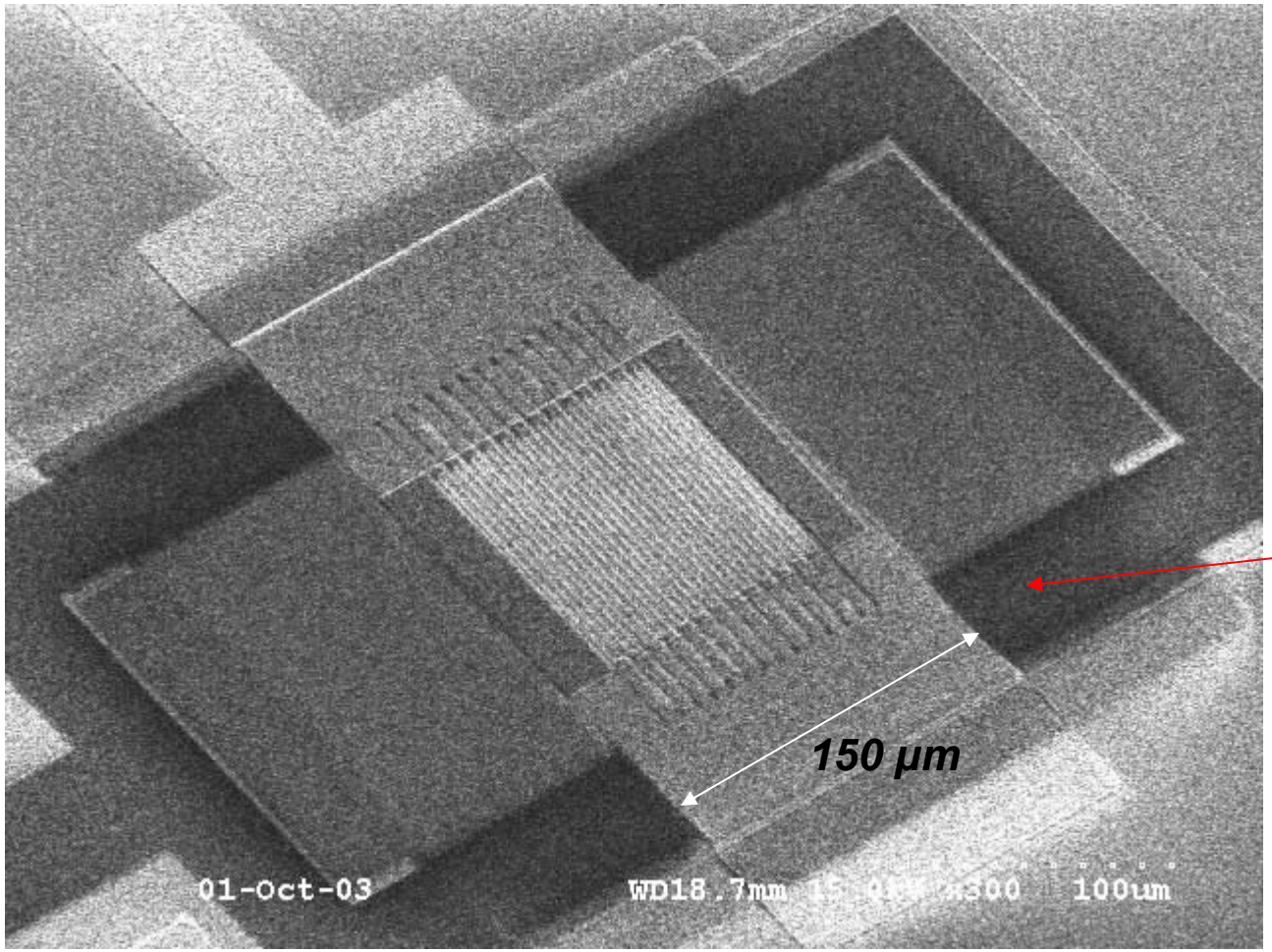
Block Diagram with PID control



Micro Interferometer



Fabricated Micro Interferometer



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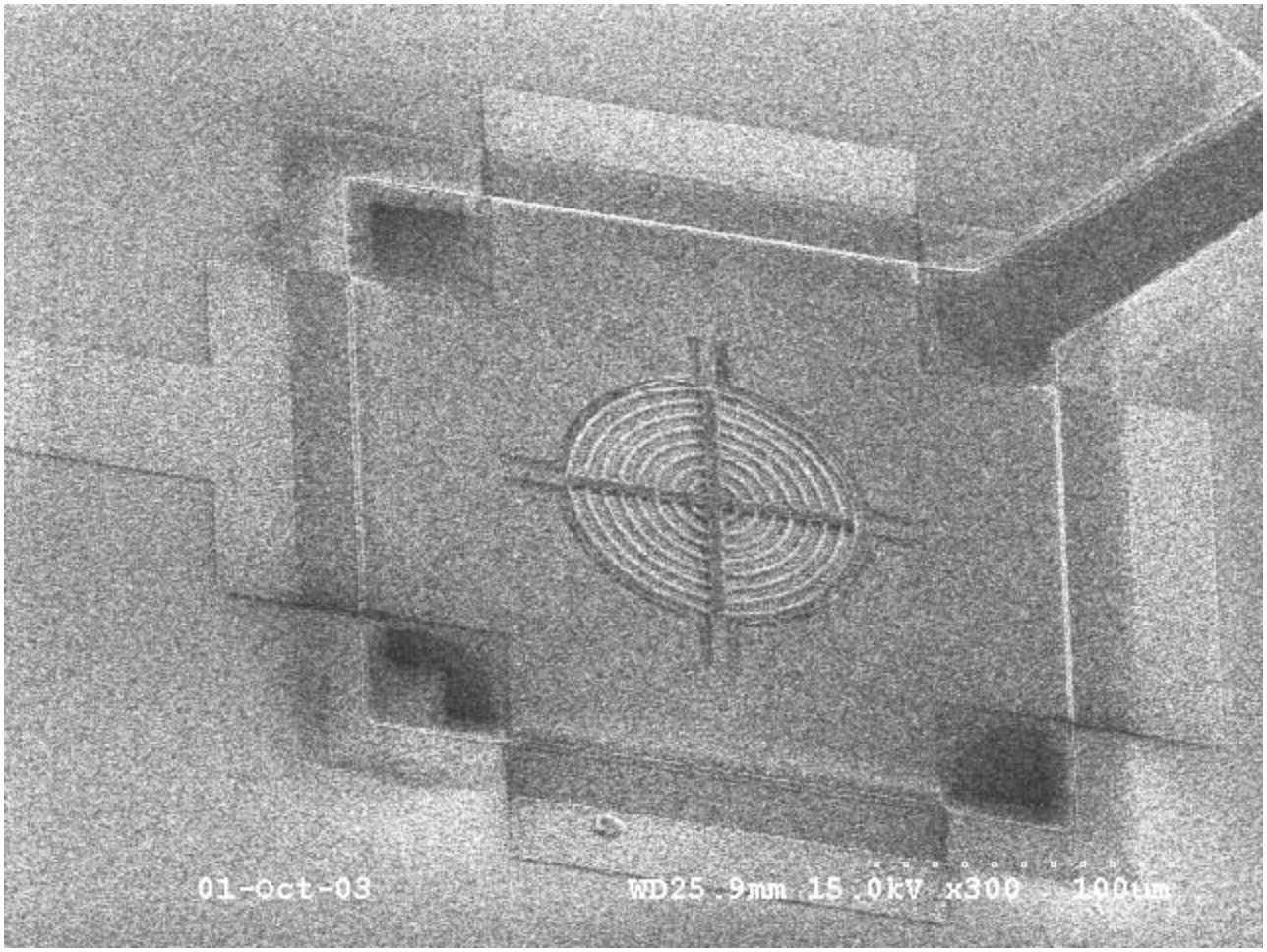
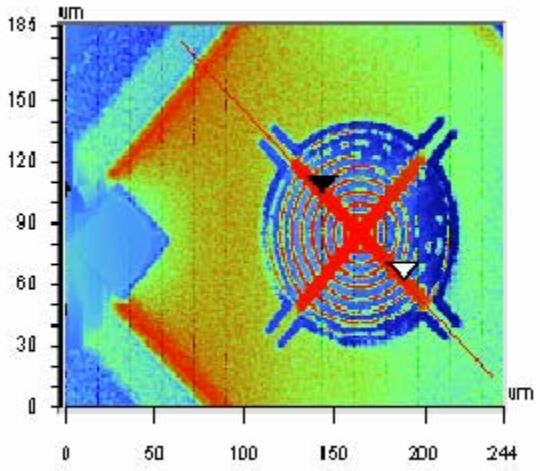
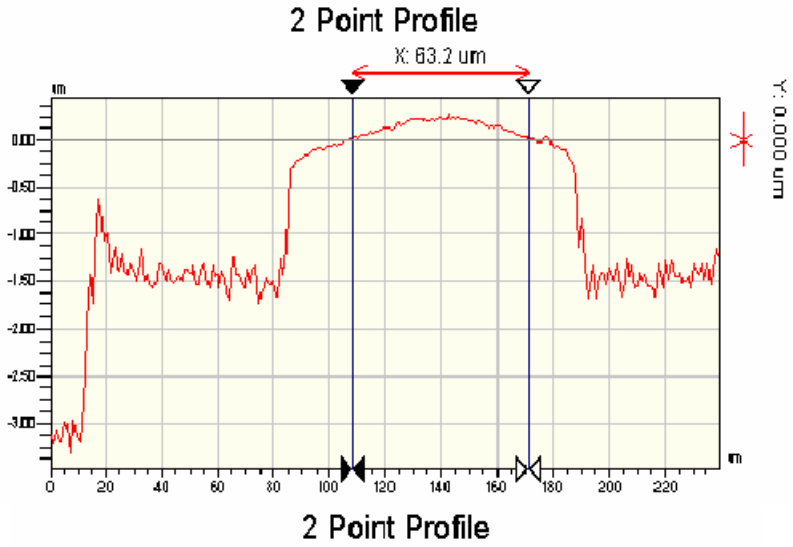


DC Biased Membrane

Georgia Tech

0 V





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